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Insect teratology. Reduplication of legs in Coleoptera, Diptera, and Hymenoptera. By E. A. Cockayne, D.M., F.R.C.P.
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INSECT TERATOLOGY. REDUPLICATION OF LEGS IN COLEOPTERA, DIPTERA, AND HYMENOPTERA

By E. A. Cockayne, D.M., F.R.C.P.

With Plates 1 to 6.

[Read 5th May, 1937.]

During the last twelve years with the aid of gifts and loans from a few sympathetic entomologists I have made drawings and descriptions of twelve examples of reduplication of legs in Coleoptera, one in a Dipteron, and one in a Hymenopteron. Monstrosities of this kind taken under natural conditions are interesting and, even if they show nothing very new, it seems advisable to publish descriptions with plates illustrating the nature of the abnormality in each case. Many published descriptions of insects with extra legs are very brief, and the figures, when a figure is given, are often small and too lacking in detail to be of much value. In order to try to avoid this defect I have drawn the affected leg only and have omitted minute details of structure, which might have obscured more essential points.

I have adopted the same classification as in my previous paper on extra wings in Lepidoptera. In this series there are no examples of simple duplicity, which would have fallen into Group I. Two specimens fall into Group II, being examples of the repetition of a leg or part of a leg, which in structure belongs to the opposite side of the body to the original leg or part of a leg. They resemble the mutant "Crippled" of *Drosophila melanogaster* described by Taku Komai. This mutant has the whole or part of a meso- or metathoracic leg doubled, the one part having the normal position and direction and the other being its mirror image. The two examples which fall into this group are the *Galerucella tenella* and the *Laccobius ytenensis*. In the *Galerucella* the trochanter of the left mesothoracic leg appears to be a fused double one, the femur bifurcates and each part gives origin to a tibia and tarsus. The bifurcated parts of the femur and the tibiae and tarsi are mirror images of one another with the dorsal surfaces apposed. It is possible that the original femur is suppressed and these are the two extra ones. The *Laccobius* has the third tarsal segment of the right metathoracic leg much thickened, and from it arise two terminal parts, each of two segments, which are mirror images of one another.

Of the remaining specimens eleven, including the Dipteron and the Hymenopteron, follow Bateson's Law and fall into Group III, though there is some doubt about the *Calosoma* and the *Carabus nitens*.

It is well known that the great majority of cases of reduplication of appendages, with the possible exception of antennae, can be shown to follow Bateson's Law, and the more complete the reduplication the easier it is to show this. Bateson himself thought that reduplication of wings in Lepidoptera was an exception to his law, but in my paper published in 1927 I proved that this is not so, and Henke and Preiss in 1930 confirmed it. As a rule only the more incomplete and imperfect examples in all Orders appear to be exceptions, and this makes one very loath to say that a reduplicated appendage does

not conform with the arrangement described by Bateson. He showed that when reduplication takes place there is an original appendage and two extra ones, the first, that nearer to the original appendage, being its mirror image, and the second, that farther away, being a mirror image of the first. Thus, if the original appendage is a right one, the first extra appendage is structurally like a left one and the second extra appendage is like a right one. Partial fusion of all three or of the two extra ones is, however, common, and suppression of parts of the original or of the extra appendages often occurs, or there may be a combination of fusion and suppression of parts, and it is this fusion or suppression that makes some examples of reduplication appear to be exceptions to Bateson's Law and makes it impossible to prove that others are in conformity with it.

It is believed that injury is the usual cause of reduplication and that the growing extremity of an embryonic appendage may be so damaged as to leave a major part, which produces the original appendage, and a minor part, which produces the two extra appendages in the imago. If the injury divides the growing point vertically, *i.e.* at right angles to the horizontal plane of the insect, the original and the extra parts will lie side by side with their dorsal surfaces uppermost, horizontal reduplication. The extra appendages, however, may be anterior to the original, subdivision A, or posterior to it, subdivision B. On the other hand, if the growing point is divided horizontally, *i.e.* parallel to the horizontal plane of the insect, the reduplication will take place either upwards or downwards, vertical reduplication, and the extra appendages will lie above, subdivision C, or below the original one, subdivision D, so that one will have its dorsal and the other its ventral surface directed upwards. In Coleoptera horizontal reduplication is much commoner than vertical, and in the present series there are seven examples of the former, but only two of the latter. Both the Dipteron and the Hymenopteron show horizontal reduplication.

The following is the list of species, the leg or part of the leg affected being mentioned in each case.

Group III A.

Agonum sexpunctatus L. (the whole of the right prothoracic leg).
Cratichneumon annulator F. (the whole of the left mesothoracic leg, with suppression of the left metathoracic leg).
Musca domestica L. (the whole of the left metathoracic leg).
Prionus coriarius L. (the femur of the right metathoracic leg).

Group III B.

Ceraglossus valdiviae Hope var. *inexpectatus* Kr.-Koschl. (the femur of the left prothoracic leg).
Lucanus cervus L. (the whole of the left mesothoracic leg).
Necrodes oculans Vig. (the femur of the left mesothoracic leg).
Carabus nitens L. (the femur of the right metathoracic leg).
Calosoma auropunctatum Payk. (the tibia of the right metathoracic leg).

Group III D.

Ceraglossus chilensis Eschsch. var. *gloriosus* Gerst. ab. *hipocrita* Kr.-Koschl. (the femur of the left mesothoracic leg).
Carabus italicus Dej. (the femur of the left mesothoracic leg).

The Hymenopteron, *Cratichneumon annulator*, is interesting, because the huge triple coxa has caused complete suppression of the metathoracic leg of the

same side, though the mesothoracic leg, which is reduplicated, is an excellent and unusually perfect example of Bateson's Law. Reduplication of any appendage is uncommon in Hymenoptera, which in the early stages are well protected from injury. In Diptera reduplication of the appendages is also rare, apart from the two mutations of *Drosophila*, in which the condition is inherited. The appendages are internal in the larval and pupal stages, and are therefore unlikely to be damaged. Several examples are recorded by Morgan, Bridges, and Sturtevant in their paper on the genetics of *Drosophila*. They give a figure (34*b* and *b'*) of one with the two prothoracic legs fused together up to the tarsi, which are separate. It is, however, possible that this is really an example of reduplication of one prothoracic leg with suppression of the other, and, if so, it resembles in some respects the *Cratichneumon* described in this paper. They also give figures of a *Drosophila* with reduplication of the left metathoracic leg, in which the two femora, tibiae and tarsi are mirror images of one another, of one with the left wing reduplicated in conformity with Bateson's Law, the two extra wings in secondary symmetry being incompletely developed, and of another with a double balancer (38*c*), the anterior one intermediate in structure between a wing and a balancer.

There is one specimen which I am unable to assign to any of the three groups. It is a *Philonthus fimetarius*. The left prothoracic leg has a femur with the distal end greatly thickened, and a normal tibia, with a tarsus of five segments, arises from the usual site, but a second tibia, with a tarsus of five segments, springs from the anterior aspect of the femur about two-thirds of the way along the shaft, and that part of the shaft, from which it springs, is not modified in any way so as to resemble the point of origin of a normal tibia. This extra tibia is slender proximally, but distally it is wider than the normal one. There is, however, nothing in its structure to suggest that it is a fused double tibia, nor does it arise from a point where one would expect a fused double tibia following Bateson's Law to arise. On the other hand, it is not a mirror image of the other tibia, nor can it be an example of simple duplicity, for only a part of the leg is double. I have seen no example of reduplication resembling it and am unable to offer an explanation of it.

Galerucella tenella L. (Phytophaga). Redbourn, Herts, 26.v.1928 (*C. T. Gimingham*).

Looking at the ventral surface of the beetle the origin of the legs is normal except that that of the left metathoracic leg is very slightly displaced outwards. The coxa of this leg appears to be quite normal, but the trochanter is partially divided by a longitudinal groove and the part anterior to the groove is divided by two transverse grooves. It may therefore be a fused double trochanter. The femur of this abnormal metathoracic leg bifurcates near the middle, and one half points directly upwards and the other downwards. The latter is shorter and less perfectly formed and gives origin to a very dark coloured tibia, much shorter and rather narrower than a normal one and curved. From its distal end arises a tarsus with only one segment, which is much smaller than a normal proximal segment. The other part of the femur gives origin to a tibia and a tarsus, both of which are well developed, the tarsus having the usual five segments, the distal one terminating in two claws.

The distal ends of the bifurcated femur and the two tibiae are mirror images of one another, but I can see no trace of a third femur. There is nothing to support the view that the bifurcated femur with its two tibiae and tarsi

represents two extra legs and that the original leg is completely suppressed, or that one of the extremities of the bifurcated femur is the original leg and that the other is a fused double leg. If neither alternative is true the leg does not conform with Bateson's Law. On the other hand, the leg is so normal at its point of origin that it is difficult to believe that the beetle is a double monster, as no doubt Cappe de Baillon would classify it. The figure shows the left metathoracic leg from behind looking at the anal end of the beetle (pl. 3, fig. 3).

Laccobius ytenensis Sharp (HYDROPHILIDAE) (*teste* H. Donisthorpe). New Forest, 15.viii.1928.

The right metathoracic leg is partially reduplicated. The third tarsal segment is much thickened and gives origin to two terminal portions, each consisting of two segments, the posterior one being shorter and thicker than the anterior one. Both appear to end in a single claw, but the claws of a normal tarsus lie so close together that it is possible that there are in reality two. There is no clear evidence that either of these terminal portions is formed by the fusion of double segments, so that is uncertain whether the specimen agrees with Bateson's Law or not (pl. 2, fig. 3).

Agonum sexpunctatus L. (Adephaga, CARABIDAE). Wassow, Stettin, 1890.

The right prothoracic leg is reduplicated. There is a very large coxa divided into two main parts by a ridge, and from the posterior and slightly smaller part a femur with tibia and tarsus arises, while from the anterior part two additional femora, each with a tibia and tarsus, arise. The coxa is triple, as is clearly shown by the fact that there are three conical elevations on it in place of the usual single one. The two posterior cones bear the normal relation to the two posterior femora, their long axes being at right angles to the ventral surfaces of the femora, but the anterior cone bears an abnormal relation to its femur, its long axis being at right angles to the anterior surface of the femur. The femur arising from the posterior part of the coxa is the original femur, the other two being the extra femora. The original femur is only slightly smaller than the femur of the opposite side, and the femur itself and its tibia and tarsus are almost perfectly formed. The two extra femora are smaller and both are a little malformed. The tibia arising from the middle femur is narrow and somewhat twisted, but the arrangement of its spines shows that it is a mirror image of the original tibia, and structurally like a left tibia. The tarsus belonging to it is nearly perfect. This is the first extra leg. The anterior leg has a tibia, structurally a right leg like the original one, and, as the spines on its tibia show, this leg is a mirror image of the middle one, and is the second extra leg. The reduplication is unusually complete and the specimen is a very perfect example of Bateson's Law. The other legs of the beetle are normal. In the drawing the ventral aspect of the legs is shown. The hollow at the distal end of each tibia is left unshaded to make the other details of structure clearer (pl. 3, fig. 1. $\times$ 24 approximately). The second drawing shows the coxa seen from the inner side (pl. 3, fig. 2).

Cratichneumon annulator F. (Hymenopt. ICHNEUMONIDAE). Female. Powerscourt deer park, Co. Wicklow, 28.vii.1926 (*J. N. Halbert*).

I am indebted to Mr. A. W. Stelfox for the loan of this insect which is now in the National Museum of Ireland.

At first sight there appears to be a fusion of the left meso- and metathoracic legs with partial reduplication of the mesothoracic shown by the presence of two tarsi fused at the base. I think, however, that this is not the true explanation. I believe that there has been an injury which caused reduplication of the mesothoracic leg and that the metathoracic leg is entirely suppressed either as a result of the same injury or owing to the pressure of the enormously enlarged coxa of the reduplicated leg. If so the whole of the left mesothoracic leg is triple, the coxae, trochanters, femora and tibiae being fused together, the one tarsus being separate and the other two partially fused. The leg takes origin from the normal site of origin of a mesothoracic leg and the femur has no white dorsal patch like a metathoracic femur, so that I think it is the metathoracic leg that is suppressed. The coxa is divided into two main parts by a groove, the postero-internal part representing the original coxa and the antero-external part, which is divided by a less distinct groove, representing the two extra coxae. The trochanter and femur show a similar arrangement less clearly. The tibia is undoubtedly a triple one. There are six large spines instead of the usual two. In the drawing, where it is foreshortened, the posterior part is the original tibia and gives rise to a single tarsus and the spines in relation to this tarsus are partly hidden, the distal part of one lying behind this tarsus and the proximal part of the other behind the middle tarsus. The two spines in relation to the middle tarsus are hidden behind it, but the two in relation to the anterior tarsus are plainly visible. To show the arrangement better I have drawn the distal end of the tibia showing its inner aspect, leaving out the tarsi, and have shown all six spines, though actually the one drawn in dotted lines is not visible, being hidden by the anterior tarsus. The first or proximal segments of the extra tarsi are fused for the greater part of their length, but a groove shows the division. The last four segments of each are free and almost perfect, though reduced in size. Though the structure of the three tarsi does not show very clearly that the two extra ones are mirror images of one another and that the middle one is a mirror image of the original tarsus, there can be no doubt that this is the actual arrangement. The whole leg is therefore in conformity with Bateson's Law (pl. 1, figs. 1 and 2).

Musca domestica L. Female. (Dipt. Muscidae.)

The specimen kindly given to me by Mr. O. J. Janson has a reduplication of the left metathoracic leg. The left coxa is very slender at its point of origin and then becomes very wide. The slender part is twisted and ridged and the wider part has an irregular surface. Posteriorly it is paler and smoother with a somewhat rounded end, from the upper surface of which arises a large seta, directed backward. Several small setae also arise from this part and point in the same direction. This portion is, I think, part of a femur. From the external aspect of the coxa arises a very broad deep femur rather shorter than that of the opposite leg and bifurcated at its distal end. From each of its bifid extremities springs a tarsus and tibia, both shorter than those of the opposite leg. That on the outer side is paler. As the drawing shows, the inner tibia with its tarsus is in structure like a right leg and the outer one like a left leg, the two being mirror images of one another. The outer tarsus is paler than the inner one, but both have five segments, the terminal segment of each ending in two claws and a pulvillus.

I think the specimen is in agreement with Bateson's Law. The coxa is a fused triple one completely twisted round, and the original femur is almost

completely suppressed. What appears to be the rounded end of the coxa is really a part of the original femur and the large seta is the ventral seta of the femur. The side of the double extra femur shown in the drawing is the second extra femur, like a left one in structure, the outer tibia and tarsus are also the second extra ones, while the inner and invisible side of the big femur is the first extra femur with its tibia and tarsus. The first extra femur, tibia and tarsus are mirror images of the original leg, only represented by a small part of the femur, and the second extra leg is a mirror image of the first (pl. 2, figs. 1 and 2).

Prionus coriarius L. (Longicornia, PRIONIDAE).

The right metathoracic leg shows partial reduplication. The femur is much thickened in all diameters; the tibia is slightly thickened at its proximal end and rapidly increases in width, bifurcating near its distal extremity. The posterior or internal part after bifurcation has the usual two spines of a single tibia, and the tarsus arising from it is normally developed, but the anterior or external part has two much shorter spines, the anterior of which is bifid and has a tarsus with unusually widened segments arising from it. The third segment, or what appears to be the third segment, has two lateral expansions like those of a normal tarsus, but there is also a central portion formed of two other lateral expansions fused together. On either side of this central portion arises another segment, the one lying to the inner side being very short, while that to the outer side is longer. If I am right in counting the segment with lateral expansions as the third, the inner segment is a complete fourth one with traces of a fifth and the outer one is a fourth one with a small aborted fifth one. The specimen is evidently in accord with Bateson's Law. The inner part of the bifurcated tibia represents the original tibia, and the outer part is really a fused double tibia representing two extra tibiae with two extra tarsi, fused or partially fused together, the inner a mirror image of the original tibia and tarsus and the outer one a mirror image of the inner one. The figure (× 8) shows the limb from the ventral aspect (pl. 4, fig. 2) and the much enlarged figure of the distal end of the tarsus shows its double nature very clearly (pl. 5, fig. 1). The most interesting feature is that the fused double tibia is not as wide as the single original one. It has only two claws, though one would expect two lateral ones and two central ones or a fused double one in the centre.

Ceraglossus valdiviae Hope. var. *inexpectatus* Kr.-Koschl. (CARABIDAE.)
Cordillera Pelado, (*Kraatz-Koschlau*), 1890.

The left prothoracic leg is partially reduplicated. The femur bifurcates near the junction of the middle and distal thirds and proximal to the bifurcation a shallow groove indicates the division into two parts; the posterior of the two branches gives origin to a normal tibia with its tarsus; the anterior branch is shorter and narrower, and though a rudimentary socket is present there is no trace of a tibia. The structure of the limb is too imperfect to show whether it obeys Bateson's Law or not. It is, however, probable that the posterior branch is the original femur and the anterior branch is a fused double femur representing the two extra ones. The figure shows the ventral aspect of the leg (pl. 6, fig. 4. × 8).

Lucanus cervus L. (Lamellicornia, LUCANIDAE). Male. Chichester, vii.1924 (*Rev. C. E. Tottenham*).

The left mesothoracic leg is triple, and at first sight appears to be an exception to Bateson's Law, but further examination shows that it conforms with it.

There is a very large coxa branching into two parts. From the anterior part springs a femur, directed upwards, with a small tibia and tarsus, the latter bent and having only three segments. The tibia is twisted, but its structure is that of a left tibia. This part of the coxa with its femur, tibia and tarsus must be regarded as the original leg. The posterior branch of the coxa becomes narrow and then widens again and from it arise two femora. The anterior of the pair is a right femur in structure and it gives origin to a small tibia and a tarsus, with only three segments, which is bent sharply backwards on itself in a ventral direction. The posterior femur, tibia and tarsus are well-formed and considerably larger than the others, though not as large as the corresponding parts of the right leg, and their structure is that of a left leg. The length of the right femur is 11 mm., of the left original femur 8 mm., of the first extra one 6·5 mm., and of the second extra one 9 mm.; the length of the right tibia is 12 mm., of the left original ? 4 mm., of the first extra tibia ? 5 mm., and of the second extra tibia 9 mm., and the length of the right tarsus is 11 mm., that of the second extra tarsus on the left is 8 mm. Thus there are two extra legs in secondary symmetry with one another, the anterior of the two being a mirror image of the original leg, and the posterior one being a mirror image of the anterior (pl. 1, fig. 3).

Necrodes oculans Vig. (SILPHIDAE) (*teste* K. G. Blair). Bedagei, Sumatra. About 600 metres. 1889 (*I. Z. Kannegieter*).

The femur of the left mesothoracic leg is very broad at its proximal end and bifurcates at the junction of the proximal and middle thirds. The anterior or external part of the femur after its division is much the broader and longer and appears to be a continuation of the main femur, though it curves slightly inwards. It gives origin to a tibia and tarsus, both well formed. The posterior or internal part of the femur after its bifurcation is almost at right angles to the main femur and widens towards its distal end, which is notched. It has no tibia or tarsus arising from it. The abnormal femur and tibia are very slightly shorter than those of the opposite leg, but the tarsus is a good deal shorter, being about 4 mm. long instead of about 6 mm. The larger part of the bifurcated femur is probably the original femur and the smaller is a fused double femur. If so, the reduplication follows Bateson's Law. The figure (pl. 4, fig. 1) shows it from the ventral aspect and the tibia is foreshortened. (× 8.)

Carabus nitens L. (CARABIDAE) (*teste* K. G. Blair). Berlin.

The right metathoracic leg is partially reduplicated. The femur bifurcates near its distal end; the outer portion is longer than the inner and each has a well-formed socket for the articulation of a tibia. From the outer portion a normal tibia and tarsus arise, both very little smaller than those of the opposite side, while the femur appears to be of normal length. From the inner portion a very short and narrow tibia arises, and this terminates in a jagged edge which may be natural or it may have been broken. There is no sign that either branch

of the bifid femur or either of the two tibiae is a fused double one. If it is, the fusion must be very complete. It is possible that the reduplication conforms with Bateson's Law, but there is no proof that it does so (pl. 6, figs. 8 and 9. × 10).

The figure is drawn with the ventral side uppermost and therefore shows the anterior aspect of the limb. Fig. 9 shows the distal end of the femur with the small and large tibiae arising from it.

Calosoma auropunctatum Payk. (Carabidae) (*teste* K. G. Blair).

The right metathoracic leg is partially reduplicated. The tibia bifurcates near its middle; the external part, probably the original tibia, has a normal tarsus, and the internal part has a tarsus with only one segment, which is both shorter and narrower than the proximal segment of the tarsus arising from the other part. The two parts are slightly rotated so that their ventral surfaces incline towards one another. It is probable that the part bearing the aborted tarsus is a fused double part representing the two extra terminal parts of the tibia, the side nearer to the original termination being a mirror image of it and the two fused parts being in secondary symmetry. Owing to the absence of additional spines on this part and the rudimentary character of the tarsus this cannot be proved, though it is probably in conformity with Bateson's Law. The figure shows the limb from the ventral aspect (pl. 6, fig. 1. × 8), and therefore represents its posterior surface.

Ceraglossus chilensis Eschsch. var. *gloriosus* Gerst. ab. *hipocrita* Kr.-Koschl. (Carabidae). Cordillera, S. America (*Kraatz-Koschlau*), 1889.

The left mesothoracic leg is reduplicated. A single femur with a normal tibia and tarsus is directed forwards and a double femur is directed backwards at right angles to the single one. Both arise from a coxa and trochanter, which are presumably fused triple ones. The reduplication is very unusual, because the original femur and the first extra one have their ventral surfaces facing one another, or to be more exact their externo-ventral aspects are facing. Thus they are mirror images, but lie venter to venter instead of side to side, and the leg is an example of vertical instead of the usual horizontal reduplication. The first and second extra femora have their dorsal surfaces fused, and on each of the free ventral surfaces there is a socket for the insertion of a tibia, as is shown in the figure. They are mirror images of one another in secondary symmetry. The first extra femur bears a vestigial tibia in the form of a small chitinous spike, but there is no trace of a tibia arising from the second one. The extra limb is very little smaller than the normal one of the opposite side. The figure shows the original and extra femora from the dorsal aspect and therefore shows their posterior surfaces. The second spine of the tibia is hidden by the proximal segment of the tarsus. The ventral aspect of the fused double femur is also figured to show the socket for the insertion of the second extra tibia (pl. 6, figs. 2 and 3. × 8).

Carabus italicus Dej. (Carabidae) (*teste* K. G. Blair). France, Dourbes, Basses Alpes.

The left mesothoracic leg is partially reduplicated. There is a single coxa and trochanter, from the anterior, really the upper, part of which arises a femur,

tibia, and tarsus, all of normal shape, though the inner spine of the tibia is much reduced in size. From the posterior, really the lower, surface a second femur arises, which is nearly as long as the other, but is ill-formed at its distal extremity and with no tibia arising from it. On examining the distal end of this femur it is seen that there are two tibial sockets, one facing that of the other femur and one facing in the opposite direction. From this it is clear that the femur without a tibia is a fused double femur, the dorsal surfaces of the two femora being fused together. The arrangement agrees with that expected by Bateson's Law, but is unusual because the reduplication is vertical and in the downward direction. The femur with a tibia and tarsus is the original femur, the other is the fused double one representing the two extra femora. The first extra femur has its ventral surface facing the ventral surface of the original femur of which it is the mirror image, and the second has its ventral surface facing in the opposite direction, and is therefore a mirror image of the first extra femur. The distal end of the fused double femur is bent over towards the original femur.

The figure (pl. 6, fig. 5. × 8) shows the leg seen from the ventral aspect of the insect and represents what is really the anterior aspect of the original femur and of the fused double femur. The other figures (pl. 6, figs. 6 and 7. × 8) represent the tibial sockets of the first and second extra femora respectively.

Philonthus fimetarius Grav. (Staphylinidae) (*teste* H. Donisthorpe). (*F. J. Coulson.*)

The left prothoracic leg is partially reduplicated. The distal half of the femur is very greatly thickened and bears a tibia and a five-jointed tarsus arising from the usual situation, but from the anterior aspect of the ventral surface a second tibia with a tarsus of five segments arises springing from a point little more than two-thirds of the way along the shaft. The extra tibia is very slender proximally, but distally it becomes wider than the original tibia. The distinctive structure of the tibia in this species should make it easy to decide whether the extra tibia is a single or fused double one, but I have been unable to satisfy myself on this point. The spines of the extra tibia are all unusually long and pale, like the two long spines of a normal tibia, though their number seems to be correct. The spines of the original tibia, however, are all short and dark, though their number too is normal. The arrangement is most unusual, and I have seen no case of reduplication quite like it. It does not appear to conform with Bateson's Law (pl. 5, figs. 2 and 3. × 128).

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Explanation of Plates.

Plate 1.

Fig. 1. *Cratichneumon annulator* F. Reduplication of left mesothoracic leg with suppression of left metathoracic leg.
2. *Cratichneumon annulator* F. Inner aspect of distal end of triple tibia.
3. *Lucanus cervus* L. Left mesothoracic leg, showing original leg L, first extra leg R′, and second extra leg L′. (× 4.)

Plate 2.

Fig. 1. *Musca domestica* L. Left metathoracic leg, original suppressed, first extra leg R′, second extra leg L′, and normal left leg L unshaded. (× 28 approx.)
2. *Musca domestica* L. First extra tibia and tarsus R′, second extra tibia and tarsus L′.
3. *Laccobius ytenensis* Sharp. Tibia and tarsus of right metathoracic leg, ventral aspect. (× 57 approx.)

Plate 3.

Fig. 1. *Agonum sexpunctatus* L. Right prothoracic leg, ventral aspect. (× 24 approx.)
2. *Agonum sexpunctatus* L. Internal aspect of triple coxa with original coxa on left.
3. *Galerucella tenella* L. Left metathoracic leg seen from behind. (× 52 approx.)

Plate 4.

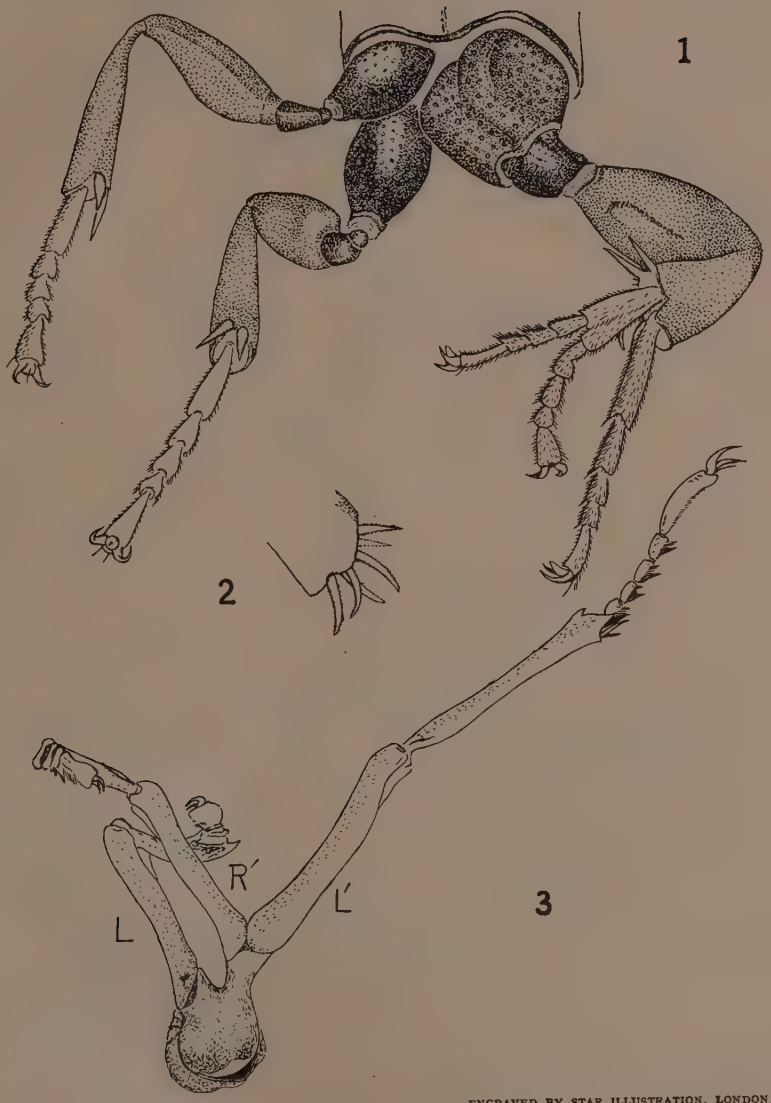
Fig. 1. *Necrodes oculans* Vig. Left mesothoracic leg, ventral aspect. (× 8.)
2. *Prionus coriarius* L. Right metathoracic leg, ventral aspect. (× 8.)

Plate 5.

Fig. 1. *Prionus coriarius* L. Distal end of fused double tarsus, ventral aspect. (× 40 approx.)
2. *Philonthus fimetarius* Grav. Left prothoracic leg, dorsal aspect. (× 128 approx.)
3. *Philonthus fimetarius* Grav. Left prothoracic leg, ventral aspect. (× 128 approx.)

Plate 6.

Fig. 1. *Calosoma auropunctatum* Payk. Right metathoracic leg, ventral aspect. (× 8.)
2. *Ceraglossus chilensis* Eschsch. var. *gloriosus* Gerst. ab. *hipocrita* Kr.-Koschl. Left mesothoracic leg, posterior surface. (× 8.)
3. *Ceraglossus chilensis* var. *gloriosus* ab. *hipocrita*. Ventral aspect of fused double femur showing socket for insertion of second extra tibia.
4. *Ceraglossus valdiviae* Hope var. *inexpectatus* Kr.-Koschl. Left prothoracic leg, ventral aspect. (× 8.)
5. *Carabus italicus* Dej. Left mesothoracic leg, anterior aspect. (× 8.)
6. *Carabus italicus* Dej. Socket of first extra tibia.
7. *Carabus italicus* Dej. Socket of second extra tibia.
8. *Carabus nitens* L. Right metathoracic leg, anterior aspect. (× 10.)
9. *Carabus nitens* L. Distal end of fused double femur showing bifid extremity with two tibiae arising from it.



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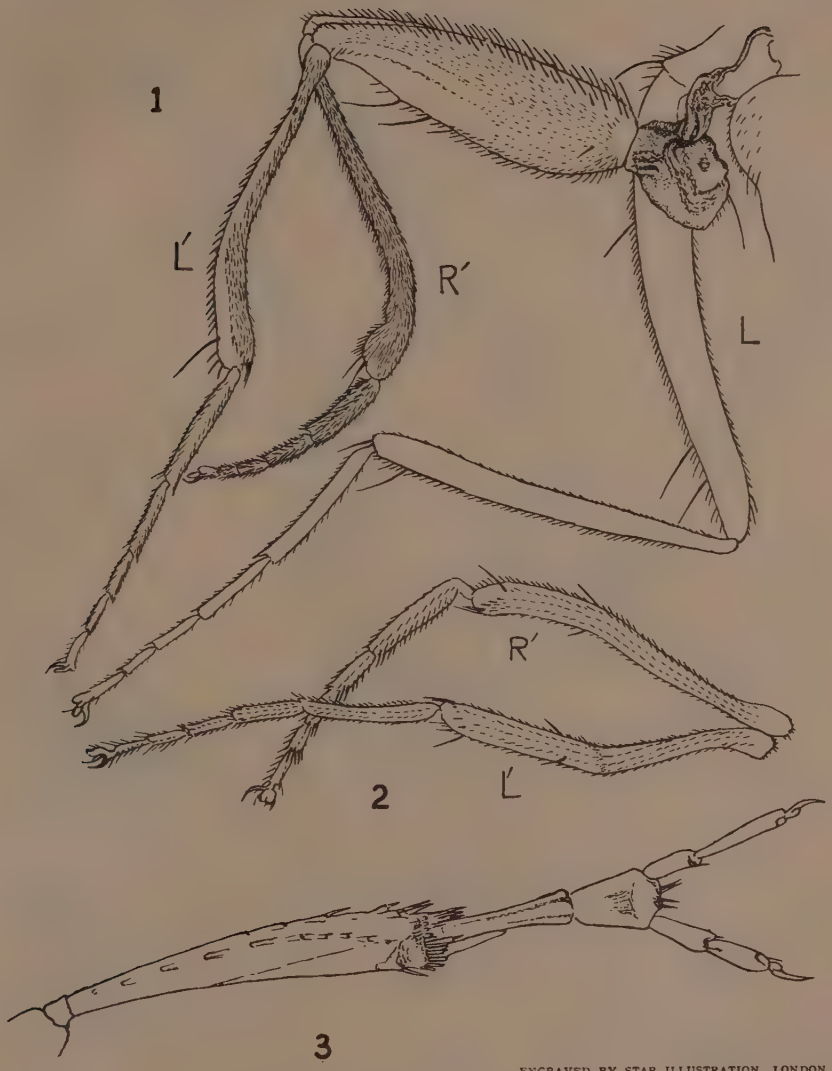
Reduplication of legs in insects.



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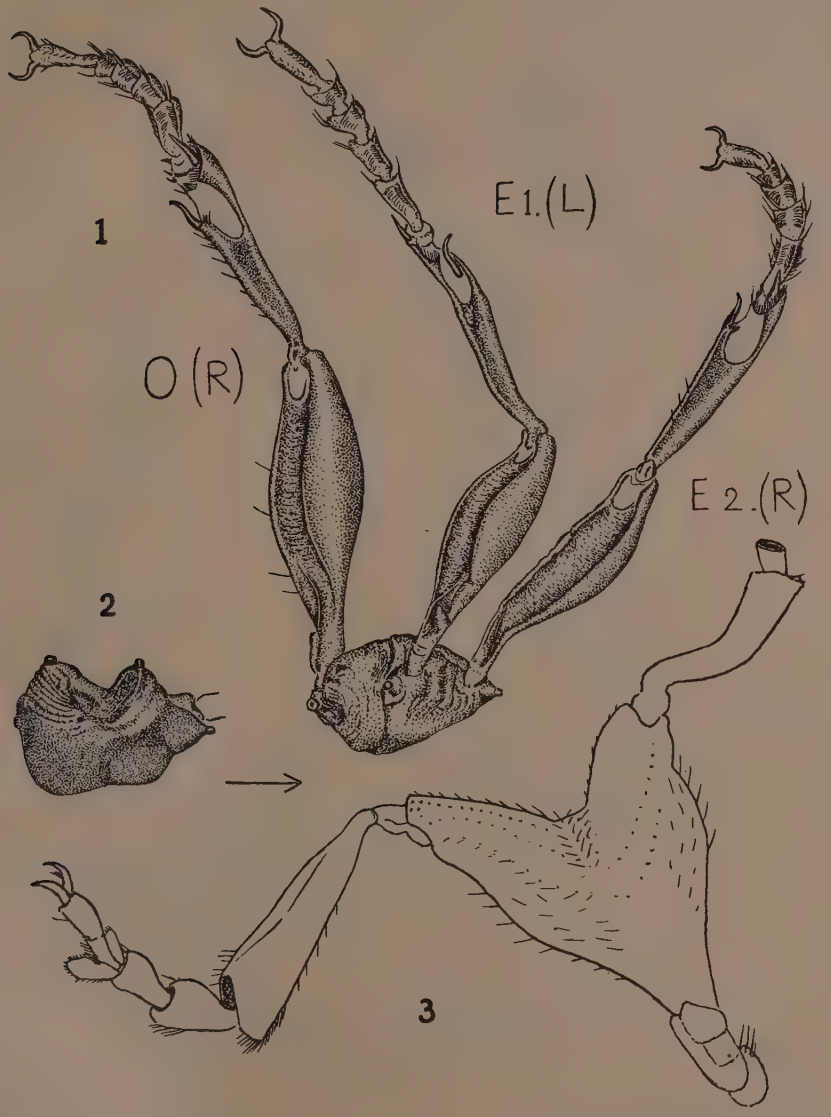
Reduplication of legs in insects.



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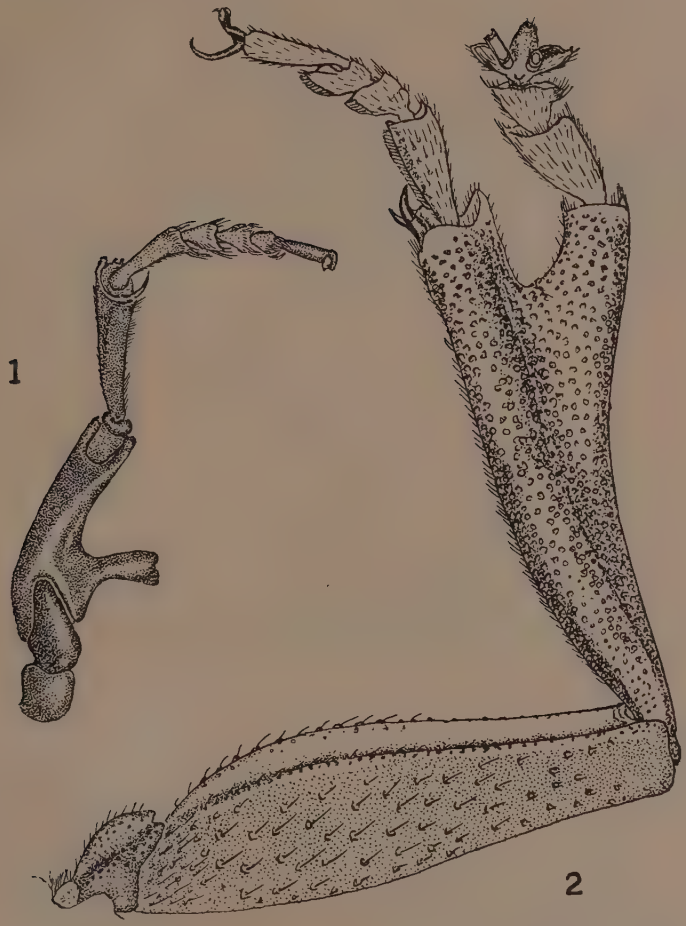

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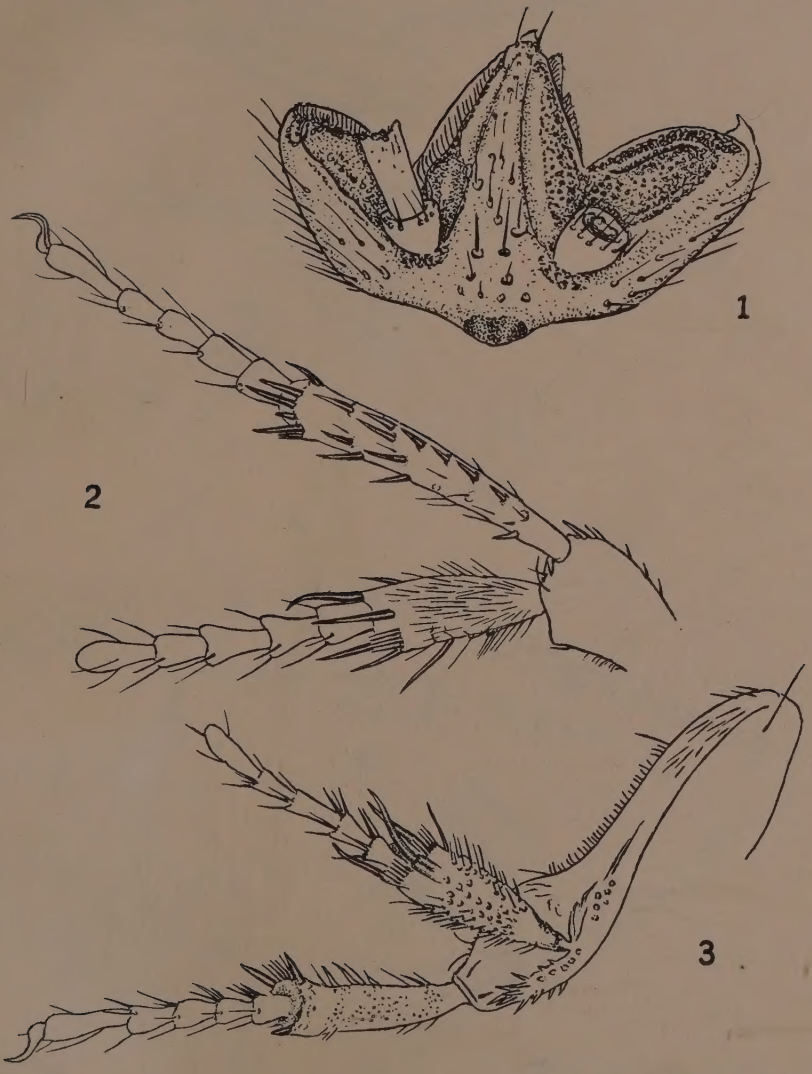
Reduplication of legs in insects.



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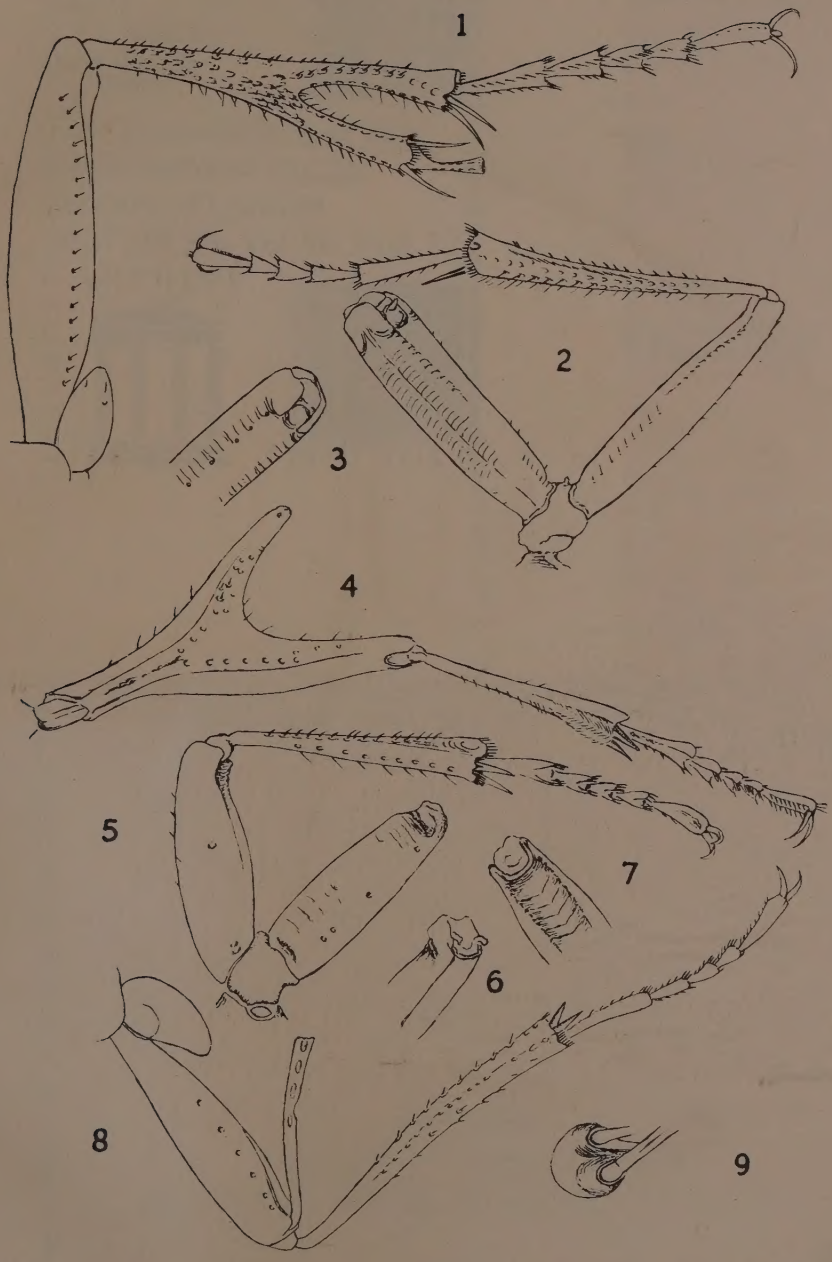
Reduplication of legs in insects.



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